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ABSTRACT

This study investigated the effect of the study skill strategies of concept mapping and cooperative learning on students' academic achievement. Forty fifth grade students were placed in three groups: (1) cooperative concept mapping groups (N=9--3 students in each of 3 small groups); (2) a standard concept mapping group (N=11); and (3) a control group (N=20). The students studied a science text and were later tested on their learning. Students in both concept mapping groups received higher scores on weekly vocabulary tests and the final unit test than did students in the control group. A reference list of 17 items and a bibliography of 20 items are provided. Appendixes include a description of the concept mapping procedure and sample concept maps. (BC)

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On the High Road to Achievement:

Cooperative Concept Mapping

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Abstract

The affect on student science achievement through cooperative concept mapping methods was investigated. Test scores were compared between cooperative concept mapping groups, standard concept mapping groups, and control groups in two fifth grade classes. Results indicated that cooperative concept mapping strategies produce higher achievement levels than do standard instruction methods. Students in both cooperative and standard concept mapping groups received higher scores than control students on weekly vocabulary tests and the final Unit test. The findings are congruent with the cognitive schematic theory and support the position that active learning and skill mastery are vital aspects to long-term achievement.

The purpose of this study is to target techniques which help students to obtain long-term academic achievement. A large number of methods to foster achievement are used daily by teachers. Some techniques may produce high test scores at the outset, but in the long run little significant academic or personal achievement occurs. A wide range of methods, however, focus on fostering independent thinking and long-term achievement. The two types of teaching methods, both intended to increase student achievement, have one critical difference between them. The first set of strategies described focus on facts to be learned, the second set targets skills to be mastered.

This study combines two teaching strategies which involve skill mastery techniques. The first technique, concept mapping, aids students in creating links between existing knowledge and new information. This is a widely used graphic technique which teaches students how to organize given material. The second method, cooperative learning, motivates students to take responsibility for their own achievement through

group interaction and personal accountability. Research shows that both methods can effect long term achievement levels because these skills require active learning and can be successfully transferred to any context. To truly effect long-term achievement levels, a teacher must show children how to learn, not what to learn.

Unfortunately, many educators assume students have learned these important skills somewhere outside of their own classroom. A study done by Durkin (1979) clearly emphasizes this point. After observing 4,469 minutes of reading instruction, Durkin did not record one example of study skill instruction or review. Durkin also observed 2,775 minutes of social studies instruction and found the same results. Interestingly, the teachers in both subjects expected their students to use these study skills in completing the assignments.

National policymakers, as well as educational researchers, have expressed concerns about the random treatment of study skill instruction. The weightiest expression of these concerns is found in the well known

report A Nation at Risk, but the concerns are also mirrored in other school reform commissions from the early 1980's. The vast majority of these commission reports reached the same conclusion: schools need to take responsibility for teaching study skills to the nation's students (Gall, Gall, Jacobsen and Bullock, 1990).

Some "good comprehenders" can almost innately do the inferential reasoning required for long-term reading comprehension and academic achievement. These students are able to grasp the main idea, assimilate, categorize, make relationships, synthesize and evaluate information (Rubin, 1983). In response to the commissioned warnings, some propose creating study skill classes to teach students not naturally endowed with these important skills. Research shows, however, that integrating study strategies with standard content creates a better learning situation (Rubin, 1983).

According to Gall, et. al. (1990), research from the field of cognitive psychology has given direction to many educators in their process of adding study skills to the curriculum. Information published in the

past decade, has shed much light on the cognitive processes involved in learning. Using these insights, educators can more clearly see that the student does not passively soak in information, but actively participates in the learning process. It is this active interaction process that provides the basis for the majority of study skill techniques.

READING COMPREHENSION

Students spend most of their academic lives reading and learning textual material. Logically then, educators need to facilitate the process of extracting and understanding main concepts in written work, as well as aiding information organization procedures. According to Stevens (1989), learning expository text is a complex cognitive interaction of three variables: state, motivation and processing variables. State variables relate to the kind of material to be read, how the information will be used, and the time available. Motivational variables concern the purpose underlying the reading and learning of the text. Lastly, processing variables involve reading

comprehension and organizational strategies for information storage and retrieval.

Most study skill techniques have focused in the processing variable. A few of these strategies include note taking, underlining, diagramming, self-questioning, summarizing, and elaboration strategies. Stevens (1989) reports that students need to engage in deep processing of the material for long term learning and achievement to occur. Self-questioning, summarizing and elaboration techniques are all integrative methods which increase reading comprehension and retention. According to Stevens (1989) "the goal of elaboration strategies is to engage students in actively processing new information presented in text and to build connections between new information and students' prior knowledge." Creating bridges between new and known information is critical to the cognitive schema theoretic descriptions of knowledge acquisition processes (Schallert, 1982, cited in Stevens, 1989).

Younger students may be more receptive to elaboration techniques because their learning patterns

are not yet firmly rooted (Butler, 1983; Stevens, 1989). Most of these strategies involve many factors and require student training to occur to maximize effectiveness. Butler (1983) found no amount of training in elaboration techniques improved reading comprehension for older students. High school student's ability to study and retain textbook content appears to be mainly dependent on reading ability. Apparently elaboration techniques can have long term impact, but are only effective when started early.

Educators have applied the cognitive schema theory to a variety of study strategies. One of the oldest and most widely used processing techniques is Robinson's SQ3R method (Devine, 1981). Generally, SQ3R has students conceptualize the overall text organization, then ask questions of the material, next read actively to discover how the author answers those questions, and lastly respond to what they read. This method has a multitude of offshoots stemming from its main trunk. Some stepchild techniques include cooperative learning groups, such as Stevens's RAVES method (Stevens, 1989) and Davey's TAG strategy (Davey,

1986).

Despite the variety in elaboration methods they all are based on the same basic principles. The two crucial elements in all the elaboration methods are summarizing information read and actively building connections between new and already known information.

CONCEPT MAPPING

Educators have also used the cognitive schema theory in creating study skills which involve graphic organizing elaboration methods. The underlying assumption of schema theory is that information is stored in the brain in categories known as schemata (Schewel, 1989). When new knowledge is obtained, the student must then place it in an already existing category. Research stresses the interdependence of prior knowledge and comprehension which strengthens the value of using category organizing study techniques (Schewel, 1989).

One such graphic technique, concept mapping, provides an organized, concrete representation of the ideas being presented. The relationships between major

concepts and their supporting details are displayed visually. Students are stimulated to relate prior knowledge to the new material by actively participating in the map making process (Johnson, Pittelman, and Heimlich, 1986). The map development is a cooperative effort of students and teachers, and is started before learning a new concept and may be reorganized as a closing activity to foster further comprehension (Schewel, 1989).

Reading comprehension requires several skills, but none are more important than word knowledge (Johnson, Pittelman and Heimlich, 1986). The primary strength of concept mapping is the positive effect this technique has on vocabulary retention. The mapping procedure introduces new vocabulary while simultaneously activating prior knowledge of the topic. Some teachers also incorporate summaries and other elaboration methods with the mapping procedures to strengthen comprehension. Concept mapping serves as the graphic foundation which guides students to relate new words to known ones.

The question of applicability of concept mapping

to all content areas has spurred much research in this area. Schwab and Cable (1983) advocate the use of semantic mapping when teaching science to children of any age. They discovered that the map's visual organization helped students to connect major concepts with the related details. This technique can easily be adapted to lessons in music, social studies, in addition to literature studies (Heimlich and Pittelman, 1986). In comparison to control groups using conventional methods, concept mapping groups have consistently scored higher on reading comprehension tests.

Research over the last decade validates the value of concept mapping as a study skill method, as well as a strategy to strengthen reading comprehension in all content areas (Schewel, 1989). It incorporates the elements of elaboration and active learning described earlier as being critical to long term comprehension and the ensuing academic achievement. Another teaching strategy which also enhances these reading comprehension skills is cooperative learning.

COOPERATIVE LEARNING

Cooperative Learning techniques have emerged as alternate methods for traditional competitive classrooms over the past twenty years. Cooperative learning techniques are carefully structured instructional methods applicable to any grade level and almost all content areas (Slavin, 1985). All methods involve teacher assigned three to six member groups composed of achievers at all levels, and students from all cultural backgrounds. Each group should closely resemble the class composition in academic achievement, sex, and ethnicity. A wide variety of cooperative strategies have developed through specific classroom and curriculum needs. The baseline of all cooperative learning techniques, however, is always the same: heterogeneous groups working toward a common goal (Slavin, 1985).

According to Johnson & Johnson (1984), four basic components must be present for small group learning to be truly effective. The first element is positive interdependence. This may be achieved through mutual goals, divisions of labor or resources, and joint

rewards. Secondly, cooperative learning requires face-to-face interaction among students. The third factor critical to successful cooperation is individual accountability in mastering the given material. Lastly, cooperative learning requires that students appropriately use interpersonal and small group skills. In addition to these vital elements, students need training and time to effectively function in cooperative groups.

Cooperative learning is not a new concept by any standard. The ability to work cooperatively has largely contributed to the survival of humans as a species (Johnson, Johnson, Holubec and Roy, 1984). People who can organize as a group to accomplish a common goal are likely to be successful in virtually any endeavor. Schools, however, have not generally focused on the area of cooperation in the classroom. Students helping one another is usually viewed as cheating, and teachers encourage students to compete with each other for all types of academic rewards.

There have been times in American education when educators advocated cooperative learning in order to

further promote the educational goals of that period. The current movement began in the mid-1970's as a strategy to improve social integration between students (Foot, Morgan and Shute, 1990). Since the original push, the many issues surrounding cooperative learning have been subject to considerable research. Cooperative learning should not be considered the panacea to all educational ills (Webb, 1985), but it should be viewed as an important method in restructuring classroom for their changing student composition.

The effects of cooperative learning methods have been studied in two main areas: student achievement and social relationships. Positive effects on social relationships include improved race relations and attitudes toward academically handicapped classmates. Group work breaks down barriers between race or ethnicity (Slavin, 1985). Achievement is promoted because students are likely to encourage and help one another to learn. Due to the subject of this paper, student achievement will be the primary focus of attention.

Johnson, Maruyama, Johnson, Nelson, and Skon (1981) conducted a meta-analysis of all studies done on the subject of cooperative learning between 1924 and 1981, in order to resolve the controversies resulting from the many reviews on social interdependence and achievement. Results support the hypothesis that cooperative learning experiences tend to promote higher achievement more than individualistic and competitive learning experiences. The results are consistent for all ages, all subject areas and for the vast majority of learning tasks. Johnson and Johnson (1983, as cited in Johnson, et. al. p. 15.) then compiled a list of factors which they feel identify the elements which contribute most strongly to the effectiveness of cooperative learning. The factors most directly related to achievement are summarized in the following results:

1. The type of learning task matters very little. Competitive and individualistic efforts are no more effective than cooperative learning on any learning task. For tasks such as concept attainment, retention and memory, cooperative efforts are usually more effective in promoting achievement.

2. Active participation in cooperative learning inevitably produces conflicts among the ideas, opinions, and information of members. If managed

skillfully, such controversies promote increased motivation to achieve, higher achievement and retention of the learned material, and greater depth of understanding.

3. Discussion among group members encourages more frequent oral information repetition. Such oral presentation of information is necessary for the storage of knowledge into the memory; it promotes long-term retention of the information; and it generally increases achievement.

The processing variable, which is vital to good reading comprehension (Stevens, 1989), is quite evident is this review of effectiveness factors. Positive effects of cooperative learning strategies on the variety of student outcomes are not found in every study or for every method. The overall conclusion to be drawn is that consistent use of cooperative learning in a supportive atmosphere will certainly benefit student's academic and social achievement.

PURPOSE

Both cooperative learning and concept mapping are study skill strategies which are learned easily and have fairly rapid results. Each method also contains all the elements required of effective achievement strategies: active participation, opportunities to

relate previous and newly obtained knowledge, and motivation to succeed. The specific objective of joining these strategies is to determine if concept mapping techniques can be successfully used to increase science achievement through cooperative learning groups.

The method's effectiveness is made through comparisons among a control group, a group using only concept mapping and a group using both concept mapping and cooperative learning. It is expected that Unit test scores from both concept mapping groups will be higher than control group scores because of their intense interaction with the material. It is also expected that Unit test scores from the cooperative learning group will be higher than all other groups due to the added motivation variable.

METHOD

Subjects

Participants in this study were forty students in two fifth grade classes from a public school in central Virginia. The two teachers coordinate science lessons

so that both classes have similar material presented at the same rate. In each class, students were identified as high-, average-, or low-achieving based upon their previous marking period grades in science. The students were initially heterogeneously mixed, as a result, one class acted as the control, the other as the experimental group. The cooperative learning group consisted of three small groups with three members in each, making for a total of nine participants. Eleven students were in the concept mapping group, and twenty students were in the control group.

Materials

Relatively few resources were needed to conduct this study. A copy of the textbook and a blackboard were essential elements. In addition, xeroxed copies of concept map outlines were given to each student in the experimental group for all three lessons and the final review. A candy reward was given to the cooperative group with the highest total score.

Measures

Students in both classes read and studied the same science text on Transport Systems in the Human Body. Experimental students used concept mapping to introduce and review lesson material, whereas control students continued receiving regular instruction. The students were given three experimenter constructed vocabulary quizzes during the study. Quizzes were administered the morning following lesson completion. The standard unit test was given after the unit was completed.

Procedure

Control. The teacher taught all lessons using the techniques normally implemented. Any method was acceptable, except for concept mapping and cooperative learning techniques. After each lesson was complete, control students were given experimenter designed quizzes. After Unit completion, control students took the standard textbook test.

Experimental. The students in the experimental group were introduced to concept mapping and given time to practice with the first science lesson, before the

cooperative groups were separated from the class. The procedure used to introduce and later implement concept mapping techniques was modified from the sequence process suggested by Heimlich and Pittelman (1986, p.21). (See Appendix A for specific steps).

The experimenter introduced the mapping process by guiding the class in developing a practice map of a well known fairy tale. The organizing purpose and use of mapping was explained to the class. Students were told that mapping would be used extensively during the course of the Unit. The following day the experimenter returned to introduce the entire Unit, but did not use concept mapping. On the third day the experimenter introduced lesson one by using the following Pre-lesson mapping procedure:

1. Tell students to write the key phrase, selected by the teacher, in the center of their paper.

2. Tell students to skim chapter and to suggest secondary headings.

3. List suggestions on the board, get student approval, select appropriate headings

4. Tell students to write these headings on lines radiating from their central phrase.

5. Have students recall facts remembered from text or prior knowledge, list on board.

6. Add suggestions to appropriate map subheadings to complete map.

(See Appendix B.1 for sample Pre-Lesson Map).

The teacher taught the lesson without altering her regular methods. The next science period following instruction completion, the experimenter gave students a "skeleton" of the Pre-lesson map. Students fleshed out the skeleton map using the following Post-Lesson Map procedure:

1. Without using notes or text, students suggest subheadings to central phase.

2. Teacher writes suggestions on the board, gets student approval, begins class copy of map.

3. Without using notes or text, students individually recalls details of subheadings and add them to their maps.

4. After all students are finished, the class shares information and finishes the class copy on the blackboard. Students may add new information to their maps.

5. Students then review text and notes and add missing information to their own maps.

(See Appendix B.2 for sample Post-Lesson map).

The morning after Post-Lesson Map completion, students took a short vocabulary quiz. Students were not allowed to consult any resources (text, notes and map) when completing the quiz.In the next science

period, the teacher introduced Lesson two by using the Pre-Lesson Map procedure with the entire class. She continued to teach the lesson in the regular manner. To complete the Post-Lesson Map, the class was divided into a standard concept mapping group and a cooperative learning group. The teacher guided the standard mapping group through the described Post-Lesson Map process.

In another classroom, the experimenter explained the new objectives and procedures to the cooperative group. Students were divided into three, heterogeneous groups of three members each. Small groups followed the Post-Lesson Map procedure as done previously in class. Students were told that each group member's score on the final test will be added to make a final group score. The group earning the highest total score will receive a prize. All members were encouraged to contribute to the group attempt to complete the skeleton maps. Students must exhaust all other resources before asking the experimenter any questions. Small groups complete Post-Lesson Maps under experimenter monitoring.

A vocabulary quiz on lesson two was given the morning after lesson completion. Lesson three was introduced by the teacher through the Pre-Lesson Map process. She then proceeded with the regular instruction of the lesson. The class was again divided into standard mapping and cooperative mapping groups to complete the skeleton Post-Lesson Maps. The same respective procedures were followed for each group. A third vocabulary quiz was given the morning after lesson completion.

The teacher conducted an oral review of the whole Unit with the entire class. Immediately following the oral review, the students separated into the two groups to complete an Unit Review Map. The teacher used the Post-Lesson Map procedure to guide standard map completion. For the cooperative group, the experimenter reiterated the importance of group cooperation and of individual accountability when working for the group prize. Students completed the Unit Review Map using Post-Lesson Map procedure. (See Appendix C for Unit Review Map results).

The next science period all students were given

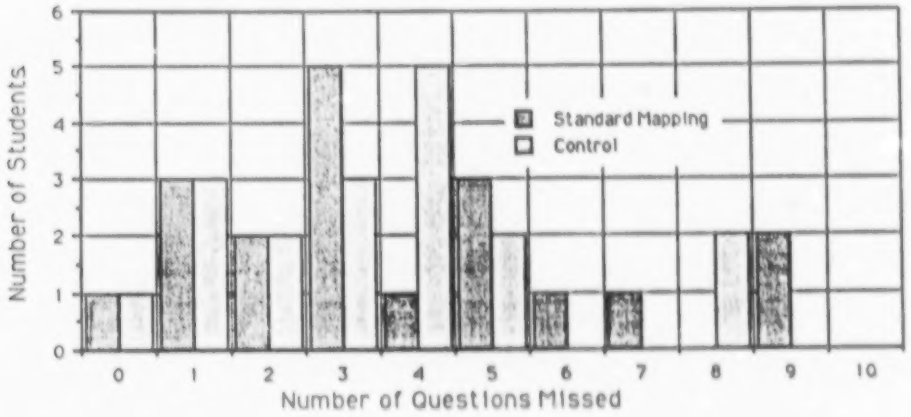
the standard Unit test. No consultation of outside resources (text, notes, and maps) was allowed during the test. The test was graded and the highest total cooperative group score was determined. A candy prize was awarded to each member in the winning group. All other students received a small candy gift for their participation in the study.

RESULTS

Quiz Data

A frequency distribution done on the scores of Quiz One showed that students in the standard mapping group most often missed three answers, compared to the control group which most often missed four answers. The range on Quiz One was 0 to 9. Figure 1.1 shows the complete distribution of Quiz One scores.

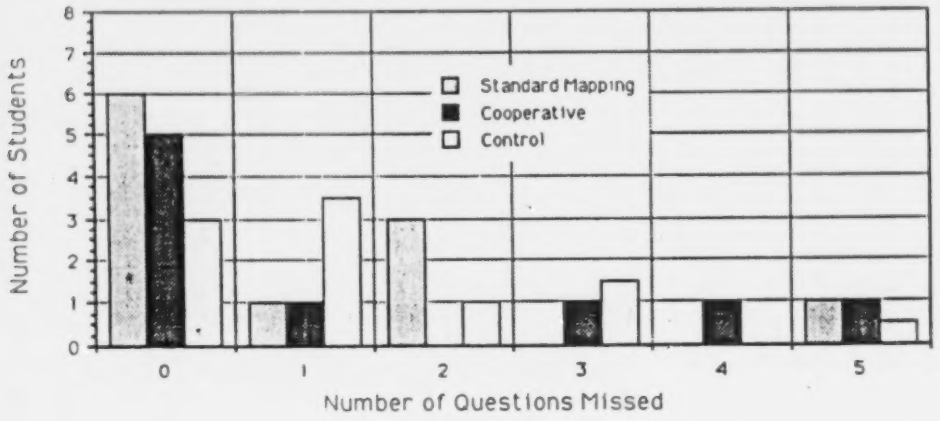
Figure 1.1 Comparison of Lesson One vocabulary quiz score distribution between the standard mapping and control groups.



In the second quiz, with a range of 0 to five, the cooperative group most often missed no answers, with the standard group mirroring the same data. Students

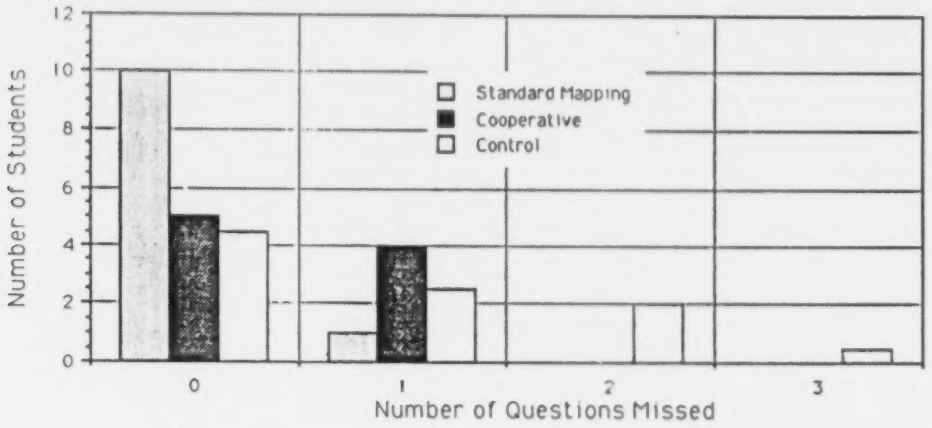
in the control group missed one answer most often. Figure 1.2 shows the complete distribution of Quiz Two scores.

Figure 1.2 Comparison of Lesson Two vocabulary quiz score distribution between the standard mapping, cooperative mapping and control groups.



The frequency distribution for Quiz Three showed the cooperative group missing no answers most often, the same result was true for the standard group. The control group most often missed no answers, with the class closely split between one and no answers missed. The range for Quiz Three was 0-3. Figure 1.3 shows the complete distribution of Quiz Three scores.

Figure 1.3 Comparison of Lesson Three vocabulary quiz score distribution between the standard mapping, cooperative mapping and control groups.



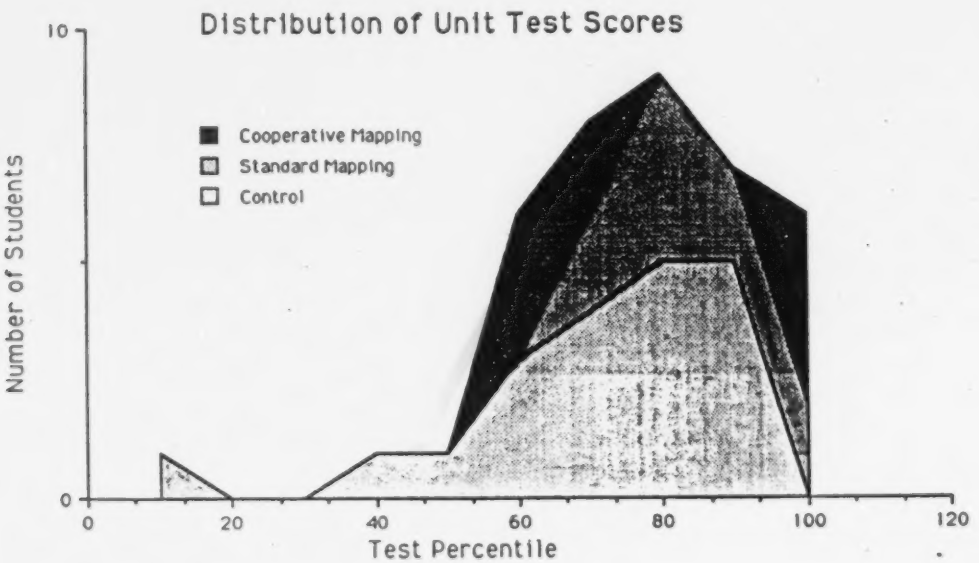
The larger number of control students compared to cooperative or standard students did not effect the score distributions. When the scores of cooperative and standard students were combined and compared to the control the frequency of scores missed remained the same. The scores for control students were normalized for graphing purposes.

Unit Test Data

The Unit test scores were analyzed by calculating

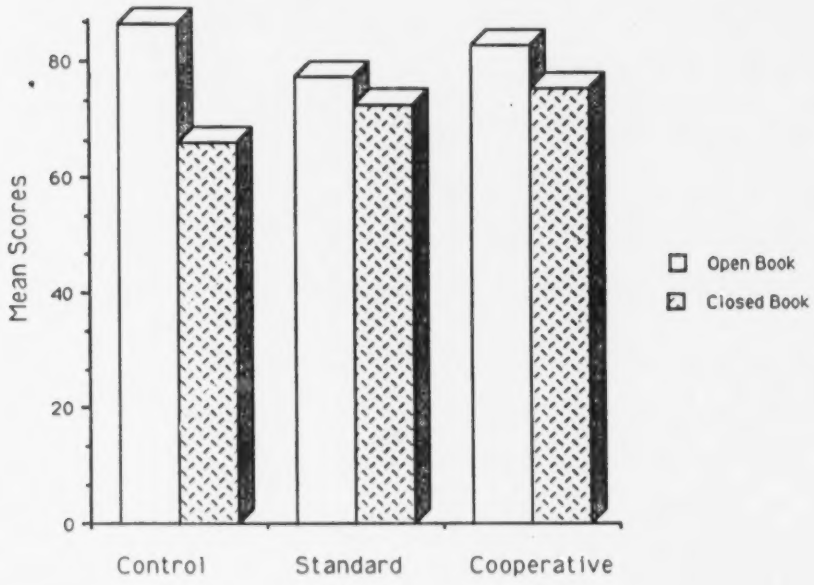
the mean of each group's score and then determining the standard deviation (s) from that mean. For the cooperative group the mean score was 75.11 with the s = 22.2 The standard group's mean was 72.57 with the s = 11.2. For the control group the mean score was 66.25 with the s = 21.7. Simple comparison of the data shows that both the cooperative and standard groups had a higher mean recall of unit information, the cooperative group having the highest mean recall. Figure 2.1 shows the full distribution of scores from all three groups on the Unit test.

Figure 2.1 Distribution of Unit Test Scores (Experimental closed book test)



Mean scores from the Unit test (taken with closed books) were also compared with scores from the previous Unit test (taken with open books and no experimental methods used). Standard deviations for the open book test means were also calculated. The standard deviations for each group did not alter significantly from the standard deviations found for the closed book test; cooperative s = 22.2, standard s = 14.7, control s = 21.7. The comparison open book to experimental closed book mean scores shows the cooperative group to have dropped 7.49 mean points. The standard group dropped a mean 4.54 points. The control group dropped 20.05 mean points. Figure 2.2 shows the complete comparison of both Unit test scores for all three groups.

Figure 2.2 Comparison of mean group scores for the Unit Test. (Non-experimental open book results compared to experimental closed book results).



DISCUSSION

The results of this study indicate that concept mapping techniques used in cooperative learning groups did increase student achievement in science. Although, the mean scores for the Unit test went down in comparison to the mean scores from the previous test, it is critical to note that one test was closed book and the other open book. Prior to the experimental condition, the teachers of both classes had administered all science tests in an open book manner. The experimental group's test scores stayed relatively the same, despite the increased difficulty in the testing situtation. The mean scores in the cooperative group dropped only slightly (7.49 points) compared to the drastic shift (20 points) in the control group. These results clearly indicate that cooperative learning and concept mapping can be used jointly to increase both comprehension and achievement.

Using only the mean scores, it appears that the cooperative group scored high on the average. The distribution of scores shows a different picture. (See Figure 2.1). The highest scores and lowest scores of

the class were found in the cooperative group. No students scored in the middle range. The achievement levels within the total group varied greatly. Both the highest and lowest class achievers were chosen to be in the heterogeneous cooperative groups. The normally high achieving students did exceptionally well. Conversely, the students who are generally low achievers did exceptionally poorly. These students were not able to truly learn the material through concept mapping, and later had no outside resources to use for the test. The data clearly shows which students actually learned the material and which students are "book dependent."

Although ethusiastic about being in a small group, students generally did little cooperation. The cooperative learning process was reiterated before all three mapping exercises, but students found it difficult to truly work together to complete the assignment. Students copied answers, ignored group members, and got off task easily. However, the concept of cooperative mapping should not be dismissed completely. Future research should concentrate on

separating the variables effecting the cooperative learning groups. The training and practice variables especially need to be studied.

It is possible that the concept mapping strategy is not well suited to larger groups. A pair of students may be able to work together in a more cooperative fashion than the group of three or four which is generally suggested for cooperative learning. Students may also need more extensive training and practice in the cooperative method than was provided in this study. It may be difficult to change the patterns formed in years of competive learning with three weeks of cooperative learning techniques. As suggested, however, in Johnson & Johnson (1984), even if cooperative learning did not immediately increase student achievement, neither did it negatively effect the learning process.

Despite weaknesses in the cooperative learning groups, the strengths found in the concept mapping method lead this study to attain its goal of higher student achievement. The consistently high scores on the quizzes made by both cooperative and standard

mapping groups support the theory that concept mapping increases vocabulary retention (Schewel, 1989). The comparison of experimental mean test scores both to the control group and to past tests also supports the increased achievement findings in previous research. The students and the teacher were both enthusiastic about using the concept mapping method and indicated that they would be interested in continuing to use mapping in science or other subjects.

To adequately test the cooperative mapping effect on long-term achievement a delayed Unit test should be administered approximately two weeks after the intervention concluded. This delayed testing was not possible due to experimenter conflicts. The measures conducted were able, however, to adequately test the effect of cooperative learning and concept mapping on science achievement levels. Although the Unit test scores did drop slightly compared to past scores, it must be noted that the testing style also changed greatly. Closed book testing forces the students to use only their own knowledge. The open book method can allow students to take short cuts on learning.

Teachers can hand their students the facts, a method which may initially produce high achievement levels. A second option, is to teach students methods of learning facts. This option targets skill mastery not fact acquisition as the final goal. Both cooperative learning and concept mapping are skills which can affect long-term achievement levels because they require active learning and can be successfully transferred to any context. To truly affect long-term achievement levels, a teacher must show children how to learn, not what to learn.

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APPENDIX A

10-step concept mapping procedure:
(Heimlich & Pittelman, 1986, p. 21)

1. Explain to the students that they are going to use a mapping procedure to help them organize information for future use as a study guide.

2. Tell the students to write the key word, selected by the teacher, on their own paper with several lines extending out from it.

3. Tell students to skim the chapter and to suggest secondary headings.

4. Direct the students to write these headings on the lines radiating from their central key word.

5. Tell students to recall details without looking at their textbook and add them to their maps.

6. After each student has completed his or her own map, have the class share information and form a large map on the chalkboard. Students add this new information to their own maps.

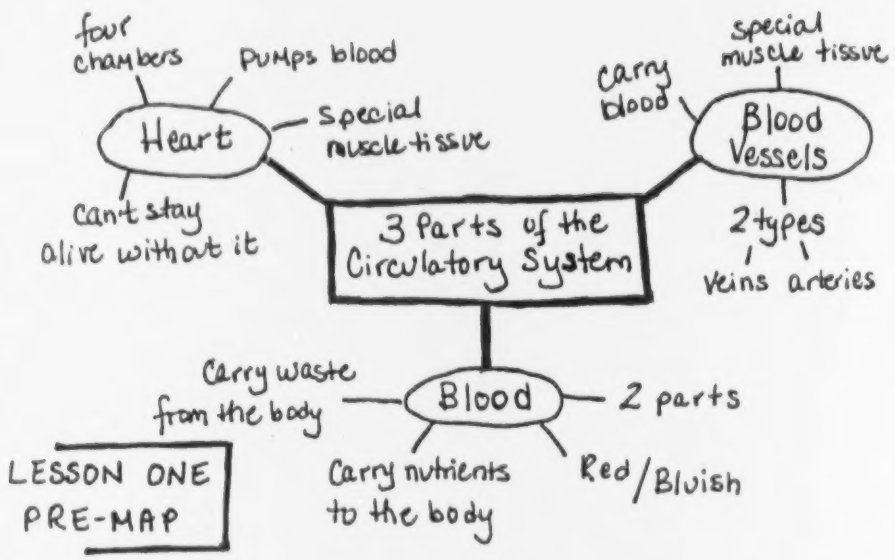
7. Students then reread their textbook and add new information to their own maps.

8. A discussion follows about any new information and new vocabulary with students making further additions to their maps.

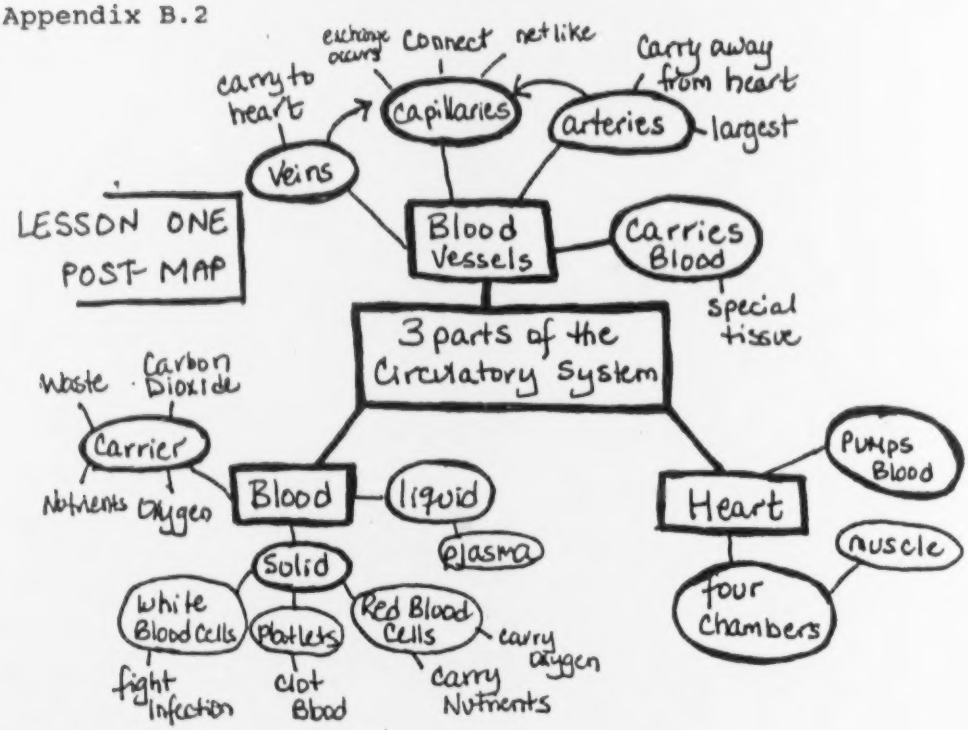
9. Students then discuss and share information on their maps and make additions to the group map.

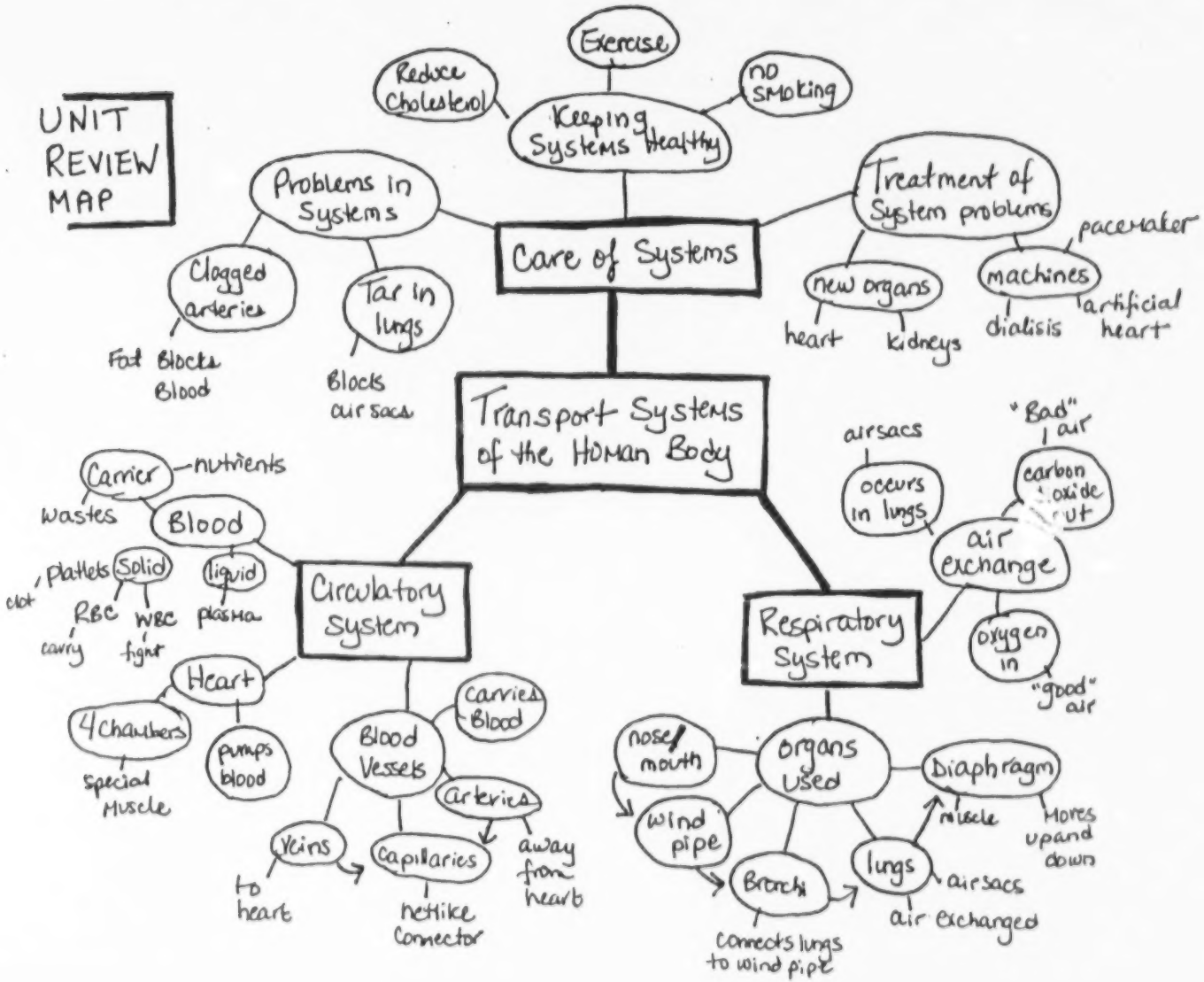
10. Each student is then instructed to save his or her map and to use it for future study and review.

Appendix B.1



Appendix B.2




UNIT REVIEW MAP
Exercise
Reduce Cholesterol
no SMoking
Keeping Systems Healthy
Problems in Systems
Clogged arteries
Fat Blocks Blood
Tar in lungs
Blocks air sacs
Care of Systems
Treatment of System problems
new organs
heart
kidneys
machines
pacemaker
dialisis
artificial heart
Transport Systems of the Human Body
Carrier
nutrients
wastes
Blood
clot
platlets
Solid
liquid
RBC
carry
WBC
fight
plasma
Circulatory System
Heart
4 Chambers
special Muscle
pumps blood
Blood Vessels
carries Blood
Veins
to heart
capillaries
netlike connector
Arteries
away from heart
airsacs
occurs in lungs
"Bad" air
carbon dioxide out
air exchange
oxygen in
"good" air
Respiratory System
nose/ mouth
organs used
Diaphragm
muscle
flores upand down
wind pipe
Bronchi
connects lungs to wind pipe
lungs
airsacs
air exchanged